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THE UNIVERSITY OF ALBERTA

AN INVESTIGATION OF THE RELATIONSHIPS BETWEEN TWO SPEEDED TESTS OF VISUAL MOTOR SKILLS AND A MEASURE OF READING ACHIEVEMENT

A DISSERTATION

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

DIVISION OF EDUCATIONAL PSYCHOLOGY

by

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EDMONTON, ALBERTA

SEPTEMBER, 1961

ACKNOWLEDGMENTS

The writer wishes to express her appreciation to the following persons for their assistance during the development of this thesis:

Dr. G. M. Dunlop for his interest in the project at all stages of its development; Mr. W. B. Dockrell, Chairman of the thesis committee; Dr. J. D. Ayers, and Dr. M. Jenkinson for their helpful advice and constructive criticisms; Mr. V. R. Nyberg, Co-ordinator of Tests and Measurements, Department of Education for the Province of Alberta, for the loan of test materials; Mr. B. Hohol, Assistant Superintendent of West Jasper Place School Division; and the school principal, teachers, and pupils of this school district who so willingly co-operated in the experiment; and, finally, to the writer's husband, for much practical assistance and encouragement.

SYNOPSIS

An Investigation of the Relationships between two Speeded Tests of Visual Motor Skills and a Measure of Reading Achievement

This study centred on an investigation of the relationships of copying ability, as measured by (a) a speeded test of form copying, and (b) a speeded test of word copying, to a measure of reading achievement, namely, the Gates Reading Survey, at the Grade III and Grade V levels.

The first hypothesis tested was that when mental ability is held constant, the relationship between a speeded test of form copying and a measure of total reading achievement will not be significantly different from zero, at the Grade III and Grade V levels. This hypothesis was upheld at both grade levels.

The second hypothesis was that when mental ability is held constant, there will be a positive but small relationship between a speeded word copying test, and a measure of total reading achievement at the Grade III and Grade V levels. This hypothesis was upheld for the Grade V subjects, but not for the

Grade III subjects.

The third hypothesis tested, nemely, that when mental ability is held constant, there will be a significant relationship between a speeded test of word copying and a measure of speed of reading at the Grade III and Grade V levels, was upheld for both grades.

A fourth hypothesis stated that form copying will show a significant relationship with a measure of mental ability at the Grade III and Grade V levels. The findings supported this hypothesis at both grade levels.

The recommendation is made that a speeded test of paragraph copying would be useful for the rapid, tentative classification of pupils above the primary level in such basic school skills as speed of reading, speed of writing, and accuracy in word recognition.

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CHAPTER I

INTRODUCTION

I. THE BACKGROUND

In his latest book, Kephart (1960), claims that form perception, as measured by copying ability, is an index of the integrative processes, and as such, is related to achievement in reading, likewise postulated by him to reflect these processes. He cites a number of studies, among them those of Lowder (1956) and Robinson *et al*. (1958) in which substantial correlations were found between the ability to copy forms, and reading achievement. A recent study by Goins (1958), not cited by Kephart, would, however, also support his claim. Goins found that, among a battery of fourteen visual perceptual tests, a test involving the copying of increasingly complex patterns yielded the highest correlation (.519) with reading achievement.

A feature of the studies mentioned is that all refer to the primary school level. This prompts the question: Do the obtained relationships still hold at levels beyond the primary? It is postulated here that while form perception is fairly closely related to

achievement in beginning reading, with increased exposure to schooling, other factors may become more important in determining reading achievement; and so the relative importance of form perception may diminish in the higher grades.

It is commonly held that reading ability is related to general intelligence. General intelligence, in turn, has been linked with the integrative processes. It is generally agreed that form perception is essential to learning to read. Certain writers postulate that form perception as measured by copying ability and otherwise, is related to general intelligence, although the existence of a specific perceptual factor "outside" general intelligence is admitted. What, then, are the relative merits of a test of form perception tests involving copying ability, and measures of general verbal intelligence, as predictors of reading achievement?

The study of copying ability in relation to reading seems to have been confined, with one exception, to form copying. Clyde (1955) correlated writing (copying) ability and reading achievement at the end of Grade I and found the correlation to be negligible. Since he reported no intelligence test scores for his

subjects, it is unfortunately impossible to draw any firm conclusions from his findings, which raise the question: Is writing, unlike reading, not related to general form perception?

Clyde observed that some of his subjects who could write (copy) adequately by the end of Grade I still could not read. Kephart (1960) has suggested that some children acquire writing merely as a "splinter" skill which is divorced from the other perceptual motor and integrative processes (such as those involved in reading). Writing, if it is merely a "splinter" skill, could be postulated to break down under conditions of stress, as when speed is required, for there is some speculation in the literature, notably in Halstead (1947), and Welford (1958) that motor speed may be an important aspect of the integrative processes. If this is so, then there is an argument for the speeding or timing of copying or other visual motor tasks which are presumed to measure the integrative processes. And here the question arises: Will speeded measures of copying ability show significant relationships with reading achievement, and particularly with speed of reading, that is, speed of word recognition.

As already mentioned, the integrative processes have been linked with general intelligence (Burt, 1949). It is therefore postulated here that since copying ability is presumed to measure the integrative processes, and since these have been linked with general intelligence, measures of copying ability should show significant relationships with measures of general verbal intelligence.

II. THE NEED FOR THIS STUDY

The brief overview above indicated the need for an investigation of:

1. Copying ability and reading achievement at both the primary and middle grade levels for comparative purposes.

2. Copying ability as measured both by form copying and word copying.

3. Copying ability as measured by speeded visual motor tasks, and their relationship to various aspects of reading achievement.

4. The value of tests of copying ability as opposed to measures of general "verbal" intelligence in predicting reading achievement at the primary and middle grade levels.

5. The relationship of word copying to form copying, that is, to general form perception.

III. THE PROBLEM

In view of the statements in the two preceding sections of the Introduction, the following hypotheses have been formulated and will be tested in the present study.

1. That when mental ability, as assessed by a verbal intelligence test, is held constant, the relationship between a speeded test of form copying and a measure of total reading achievement will not be significantly different from zero, at the Grade III and Grade V levels.

2. That when mental ability is held constant, there will be a positive but small relationship between a speeded word copying test and a measure of total reading achievement at the Grade III and Grade V levels.

3. That when mental ability is partialled out, there will be a significant relationship between a speeded test of word copying and a measure of speed of reading, at the Grade III and Grade V levels.

4. That form copying will show a significant relationship with a measure of mental ability at the Grade III and Grade V levels.

Two subsidiary aims are:

a. To investigate the relationship between a speeded test of form copying and a speeded test of word copying at the Grade III and Grade V levels.

b. To determine the feasibility of using a form copying test as a group test for Grade III and Grade V pupils, the test to involve a degree of speed and a simple scoring system.

CHAPTER II

RELATED STUDIES

The Relationship Between Intelligence and Reading

Binet devised a reading test which could be employed as a measure of intelligence (Binet and Simon, 1916, pp. 212-214). He had noted that, in general, intelligent children could read faster, and remember more of what they read than duller children. He explained the close relationship he had found between rate of oral reading and degree of comprehension in his subjects by inferring that brighter children read faster and with little difficulty, hence they could concentrate on the meaning of what they read. Duller children, on the other hand, read relatively slowly because they had trouble with the mechanics of reading, and thus they lost much or all of the significance of the content. "We might have included a test of this kind in our measuring scale of intelligence, had we not resolved to measure intelligence independently of scholastic knowledge" (Binet and Simon, 1916, p. 212).

Binet's test, almost unchanged, was, however, included by Terman and Merrill (1937) as one of the

sub-tests at the Year X level on the 1937 Revision of the Stanford-Binet, Form L. It has been dropped from the 1960 Revision of the Scale (Terman and Merrill, 1960) because in the intervening years its discriminatory value had diminshed.

Gates (1922) found a correlation of .72 between mean scores on a verbal group intelligence and a measure of reading comprehension at the Grade III level. The correlation between the verbal group intelligence test and rate of reading was .68. The correlation of total school achievement with the verbal group test was .65; with a non-verbal group test it was only .22. Gates concluded that the verbal group test was the best single predictive measure, followed closely by mental age. Although he considered that all his correlations had been attenuated by the restricted range of ability in his sample, he nevertheless felt that non-verbal group tests were not very useful predictors.

Traxler (Traxler and Jungeblut, 1960), who has been publishing summaries of research in reading for many years, states in his latest volume that numerous studies have emphasized the close relationship between intelligence and comprehension in reading, but that the relationship between intelligence and rate of

reading is not so high. The exact extent of these relationships is unknown.

It is frequently claimed that intelligence test scores derived from verbal group tests must be regarded with caution, since these tests involve reading and may thus discriminate against poor readers. Mellone (1942), however, is cited by Traxler and Townsend (1946) as having found that, within a given age group, a verbal group intelligence test arranged the children in "accurate rank order" (Traxler and Townsend, 1946, p. 140). Traxler and Townsend (1946) also cite Blair and Kamman (1942) as having obtained results similar to Mellone's with students at the college level. These findings would tend to substantiate the view that reading reflects the application of intelligence. Nevertheless, as clinical studies show, children of average and even high intelligence sometimes fail to learn to read, or read below their potential because the facilitating factor of intelligence has been overwhelmed by inhibiting factors arising from the child's internal and/or external environment. On the other hand, children of limited intelligence may learn to read in line with their mental ages, as Kirk (1940) has shown.

Robinson (1946), in a review of the literature,

concluded that the correlations between measures of intelligence and reading achievement were not sufficiently high to allow the prediction of one from the other with confidence. She went on to say: "It is known that intelligence ratings are obtained by measuring a number of abilities and combining these into a composite score. Consequently, when tests of the primary mental traits are standardized, a profile of intelligence should show factors more closely related to reading than the general score. This, in turn, should lead to more adequate predictions of reading expectancy" (Robinson, 1946, p. 73).

Motor Abilities

Bousfield (1953) states that development of the motor areas of the human brain appears to precede development of the other areas. McGraw's (1946) review of the literature on the maturation of behavior indicates that motor development is relatively precocious. Piaget and Inhelder (1956) regard behavior in the first year of life as manipulatory, that is, motor. Later, according to the same authors, sensory-motor activity, mostly concerned with eye movements, appears.

The study of the mental growth of the young child

is largely the study of his sensory-motor development, and mental tests for infants and young children are measures of sensory-motor skills. Infant "intelligence" scales have been much criticized for their lack of validity as predictors of future status (Cronbach, 1960, pp. 209-210). The implication in this criticism seems to be that sensory-motor tasks have little to do with the verbal and conceptualizing skills required for success on mental ability tests and in school work at later stages of development.

However, the low validity of infant scales may be in part a function of their low reliability. Cronbach (1960) indicates that such tests are unreliable because of the child's fluctuations of attention and of development from test to test.

That the value of infant scales has been underestimated by commentators who have attempted to interpret them too strictly in terms of intelligence quotient, has been suggested by MacRae (1955). During the years 1950-1952 he re-tested one hundred two children who had been originally tested in 1941 when all were below the age of three, and found that sixty-five per cent of the subjects fell into the same ability categories as before.

At the school age level and beyond, are motor abilities related to intelligence? Goodenough (1949) has pointed out that there is no general motor ability, comparable with "general intelligence;" rather, there are specific motor abilities which may bear little relationship to each other. The correlations between motor skills and intelligence were not high enough, she concluded from a survey of the literature, for prediction of the one variable from the other.

Wellman (1931) considered that the degree of relationship between motor abilities and mental ability would depend upon the type of motor tests used. Goratos (1959), in a study of the interrelationships of motor abilities, found that measures of mental growth and measures of reading were more closely related to motor skills requiring the understanding of instructions, fine co-ordinations, and frequent shifts of movement, than to measures of gross muscle skills.

According to Whipple (1914, p. 144), Burt found correlations ranging from .41 to .65 between tapping scores and intelligence. Burt (1949) reported that factor analysis of complex motor tasks showed that the execution of these tasks is dependent mainly on general intelligence, and to a lesser extent upon a specific motor factor.

There is some evidence that, at the extremes of mental ability, there may be a fairly close relationship between motor skills and intelligence. Thus, Manahan (1927) found intellectually gifted children of intelligence quotient 135 + to be superior to children from regular classes on measures of motor performance which required muscular energy, such as tapping and gripping.

In a study of the motor characteristics of the mentally retarded, Francis and Rarick (1960) found that age equivalents of motor performance parallelled mental age for the majority of the motor tests used in their investigation.

Guilford (1958) believes that it may be possible to identify specific factors in the motor field, comparable to Thurstone's (1938) primary mental abilities. Guilford also postulates that there may be a general motor-speed factor.

Monroe (1935) obtained a correlation of .50 between the scores on two speeded paper-and-pencil type motor tests and reading achievement in eighty-five Grade I children. These motor tests involved no symbolic material.

Halstead (1947) was of the opinion that, in

adults, performance on a speeded motor task might be very vulnerable to "set." Thus, on a new speeded motor task, the individual might perform below his potential because of the influence of his habitual rate of motor expression in routine tasks. It is of interest to note that Halstead obtained a significant, though not substantial correlation (.323) between a very simple speeded test of finger dexterity and the scores obtained on the Henmon-Nelson Tests of Mental Ability for fifty adult subjects. This correlation was significant at the .01 level.

While the evidence on the relationship between motor tasks and intelligence is somewhat inconclusive, it seems justifiable to believe that when motor tasks involve a certain degree of complexity, the following of detailed directions, or fine co-ordinations coupled with speed, these motor tasks will show a positive relationship with measures of intelligence and possibly with some aspect or aspects of reading skill as well.

Townsend (1951) reviewed the literature on motor abilities and concluded that all investigators had found an increase in motor development with age.

Visual Perception and its Relationship to Other Variables

Binet (1907) regarded perception as unconscious reasoning. Burt (1949) states that Spearman considered discrimination to be the essential element in general intelligence. Burt himself found, however, that when general intelligence is partialled out, a factor for perceptual discrimination may still be discerned. "This further factor, entering into the group of perceptual tests, and into these alone, seemed to be a factor for the formal activity of discrimination" (Burt, 1949, p. 109).

Thurstone's (1938) factorial analysis of a large battery of experimental tests for the purpose of identifying the primary mental abilities revealed the presence of a factor unforeseen by him in the planning of his investigation. He named this factor P, and related it to speed of visual perception. He hypothesized that P might play an important part in reading, especially in speed of reading. A later study (Thurstone, 1944) confirmed this hypothesis at the college freshman level, since tests of P differentiated fast and slow readers. In a study at the upper elementary

school level, however, he obtained low, zero, or negative correlations between P and measures of reading vocabulary and reading comprehension (Thurstone, 1941).

Thurstone had observed that P tended to show up on speeded tests that were relatively easy for a given sample of subjects. Since all the tests in his original battery were speeded, he felt that he had no base from which to measure P. By giving both speeded and unspeeded tests in a special study of visual perception (Thurstone, 1944) he was able to break it down into three "gestalt" factors named "speed of closure," "flexibility of closure," and "strength of closure," respectively.

Thurstone suggested that the P factor might mature earlier than the verbal (V) or inductive (I) factors, and that it might vary from age level to age level (Thurstone, 1941, p. 87). Since he found it to be unstable he decided not to include it in mental profiles (Thurstone, 1941, p. 35).

That intelligence may be measured through visual perception has been demonstrated by Raven's Progressive Matrices (1938). The Matrices are a test of "eductive ability" (general intelligence), according to Wechsler

(1949a). As such, they involve much more than simple discriminations of likenesses and differences and call for the ability to analyze the figures presented, to recognize complex relationships, and to make figural analogies. The Matrices are, in short, a qualitative measure of visual perception. In this respect it is of interest to note that Goins (1958) found fairly substantial correlations between what appear to have been the most difficult of a group of visual perception tests and the Stanford-Binet and the Kuhlmann-Anderson intelligence tests. This same group of visual perception tests also correlated substantially with reading achievement in her study.

Malmquist (1958) has stated that "visual perception is dependent to a great extent upon higher mental processes. Consequently, we may expect a fairly high correlation between scores on visual perception tests and scores on intelligence tests" (Malmquist, 1958, pp. 273-274. She obtained a correlation of .415 between visual perception and intelligence as measured by the Terman-Merrill in a sample of 398 Grade I children. The correlation between visual perception and reading comprehension in his study was .326; between visual perception and oral reading (which he regarded

as measuring the mechanics of reading) the correlation was .227.

Neither Goins (1958) nor Malmquist (1958) partialled out intelligence in their studies. This fact is to be regretted, since the elimination of intelligence would have shown the relative importance of the visual perception factors measured, as distinct from general mental ability, in relationship to reading achievement. It is true that Goins obtained higher correlations between four of her visual perception tests and reading achievement than between the intelligence test scores and reading achievement, but it is not known whether the differences were significant. The visual perception factor named by Goins "strength of closure" (Goins, 1958, p. 80), which had high loadings on the four tests mentioned and which involved motor and kinaesthetic-spatial responses might,too, be postulated to include a maturation element as well as visual perception, hence, it would also have been desirable for Goins to have eliminated the effects of chronological age. The point at issue is, were Goins' "strength of closure" tests measuring only visual perception, or other factors as well?

Some of Goins' visual perception tests had low

correlations with both reading and intelligence test scores. These were tests which required relatively simple discriminations. They were also, unlike the "strength of closure" group of tests previously mentioned, highly speeded. The factor of speed may have reduced the correlations, since this factor played little if any part in both the intelligence and reading tests. The "strength of closure" tests may have shown higher correlations with both the intelligence tests and the reading tests partly because the time factor was not important in any of them.

Gates (1926) gave visual perception tests including the recognition and discrimination of (i) geometrical figures, (ii) digits, (iii) words and letters, and (iv) pictures of objects, to three hundred ten pupils in Grades I to VII. He found only the tests involving words and letters to have substantial correlations with reading achievement. The average of the correlations between the other visual perception tests and reading was only .245. When mental age, as measured by the Stanford-Binet, was partialled out, the correlation between word and letter perception with reading was still relatively high, namely .47.

Gates concluded from this study that visual perception is not a unitary trait, but rather, there are visual perceptual abilities which are evoked by different types of stimulus material. Since some of his subjects with high scores on the tests involving geometrical figures, digits, and pictures had low scores in reading; and some of the best readers had low scores on these visual perception measures, Gates suggested that a relatively low level of visual perception might be adequate for learning to read.

Subsequent studies have confirmed Gates' findings in that higher correlations were obtained between visual perception tests involving words and letters, and reading, than between visual perception tests not involving words or letters, and reading. Goins (1958) summarizes some of these reports. Sister Mary of the Visitation (1929) in an investigation very similar to Gates',and with similar results came, however, to the conclusion that the intercorrelations between all the tests of visual perception, whether of forms or of letters, words, and so on, yielded evidence for the possibility of the existence of a group factor of visual perception. Fendrick (1935) again in an investigation similar to both those of Gates

and of Sister Mary, found higher correlations between tests of word and letter perception, and reading, than between form perception and reading; but only one of the perceptual tests (one of Gates', involving geometrical figures) appeared to prevent the identification of a unitary perceptual factor.

A point that seems to have been ignored by Gates (1926) is that a high correlation between a word and letter visual perception test and reading is to be expected, since letter and word perception is a school trained skill and an integral part of learning to read.

Malmquist (1958), with Grade I children, also found that the ability to discriminate between words and letters was more closely related to reading achievement than was the ability to discriminate between geometrical figures, pictures, and shapes. Her general conclusion, in which she supported Gates, incidentally, was that visual perception is an important element in learning to read.

Logically, it would seem that visual perception may be a more vital factor in determining reading skill at the beginning reading stages than later when, presumably, training in reading skills might make up for

a deficit of visual perception. That general form perception may be relatively unimportant once reading has been acquired, was suggested by Stroud's (1945) study of 475 subjects in Grades IV, V, and VI. He differentiated between his subjects as fast and slow readers. Some of the slow readers made very high scores on tests of visual perception involving words, letters, and digits; while some of the fast readers made low scores on the tests of visual perception.

Sister Mary Nila (1953), in a study of factors related to reading achievement at the Grade I level, found that visual discriminative ability for some children was more important than mental age in determining reading skill.

That visual perception may play a significant role in cases of severe reading disability, is a frequent suggestion in reports of clinicians. Thus, Malmquist (1958) cites Ranschburg (1916) as having believed that poor visual perception of words was always a factor in cases of reading disability. Fildes (1921), also cited by Malmquist (1958), found such children had special difficulty in distinguishing between forms which were only slightly different

from each other. Again according to Malmquist (1958), Skydsgaard (1942) found that gross visual perceptual defect was manifested by only a few of his cases of reading disability, but like Fildes he noted that, typically, such children were unable to detect minor differences of detail in visual patterns, whether forms or words.

That difficulties in the visual perceptual field may be of a cognitive nature has been suggested by Vernon (1958). It also appears likely that, since emotional factors can distort perception (Freud, 1931), in some of these cases emotion, rather than perception *per se*, may be the limiting factor. Smock (1958), for example, found clear evidence that reduced perceptual efficiency accompanies high levels of anxiety such as may be induced by deprivation or an unduly strong need for goal-attainment. He administered part of the Street Gestalt Test to 127 Grade V children as a measure of perceptual closure, and a series of pictures showing the figure of a cat gradually changing to that of a dog, as a measure of perceptual rigidity. Speed of recognition of the change from "cat" to "dog" determined the subject's level of perceptual rigidity. The index of anxiety was the Children's Manifest Anxiety

Scale. Four months later he administered a second series of these tasks. His findings indicated that children with high degrees of anxiety scored significantly lower than non-anxious children on these perceptual tests.

That the acquisition of meaning is of great importance in the act of perceiving, has been stressed by students of perception and of the reading process. Vernon (1931) says: "Perception always seems to involve some attribute of meaning. . . . If there is some difficulty in understanding the meaning of the percept, there will probably be confusion in consciousness while the relevant experiences are recollected or compared" (Vernon, 1931, p. 102). Bruner (1958) claims that a theory of perception must postulate a process for making inferences and for classifying just as much as does a theory of cognition. Johnson (1955) states: "Regardless of materials or contents, the processes of thought and the processes of perception have much in common."

Thus, there seems to be fairly general agreement that perception is akin to thinking. Since thinking is involved in intelligence, or rather, in the functioning of intelligence, a relationship between perception and

intelligence may be postulated. To what degree visual perception may be separated from intelligence is a problem which awaits further investigation.

The getting of meaning from visual perception appears to determine eye movements in reading. Vernon (1958), referring to studies of the role of eye movements in reading says, ". . . it has been made abundantly clear that, except possibly in cases of ocular defect, it is failure to attend to and to comprehend what is read that causes irregular eye movements and regressions" (Vernon, 1958, p. 122). She goes on to say that children with faulty eye movements require to learn first the mechanics of reading, and then to understand what they read, rather than orthoptic training. Studies by Tinker (1938), and Sisson (1939) support this viewpoint, although Tinker found that when only the extremes of his group were considered, there was a slight but consistent relationship between motor efficiency of the eye and reading achievement.

Gesell _et al_. (1949) studied visual perceptual growth from several aspects, including the study of eye movements. They interpreted the eye movements of a child as an indication of whether he was grasping the meaning of what he saw. Assuming this, they

virtually made of retinoscopy a test of intelligence! (Bartley, 1958, p. 82). It is not without interest here that Binet included tests similar to some of Gesell's (for example, "fixation of visual regard") in his original intelligence scale. Binet used these for the assessment of very low levels of mental development (Binet and Simon, 1916, p. 43 ff).

The introduction of the topic of eye movements into a discussion of visual perception underlines a major difficulty in the study of perception as a whole--namely, that perception cannot be observed directly but may only be inferred from the motor responses that are made to it. The study of perception thus involves a consideration of the motor elements in perception.

Many tests of visual perception may be seen as measuring this function in a somewhat devious, global fashion. Tests which require the subject merely to match the two similar or identical objects in a group, are of this nature. The motor response noted here is not the immediate response to perception, it is partly a response to the test instructions. A measure of the immediate response would require the recording of eye-movements and of other muscular accompaniments of the

initial act of perceiving. Since many of the immediate responses to perception are non-overt, their measurement may be difficult without the use of elaborate electrical devices designed to register the changes in kinaesthesis or muscular tension as the individual perceives.

Overt responses, on the other hand, are readily observable. It was a realization of this fact that led Bender (1938) to invent her Visual Motor Gestalt Test for the study of both perception and motor elements as they function together. For Bender, there was no strict dichotomy between the perceptual and the motor processes. It is to the perceptual motor processes, and their possible integration, that attention will now be directed.

Perceptual Motor Processes and the Concept of Integration

Bender (1938) claimed that there is an innate tendency to see configurations, not only as wholes, but as wholes which are in the process of becoming, as are the units of the physical world, according to Eddington (1929).

In this state of becoming there is a spatial element, a temporal element, and the nature of the object itself. When the object or unit is a person, he contributes in a dynamic way to this state of

becoming. He does so by organizing his impression of the outside world and his reactions to them into new spatial and temporal structures. This process, Bender postulated, involves the whole individual, with his past learning experiences, his soma and psyche. All behavior is therefore an expression of the total personality. Thus a task such as the copying of designs on the Bender Visual Motor Gestalt Test will not merely indicate a subject's perceptual and motor functioning, it will reveal his total functioning at the time of testing.

The organization, or, rather, the re-organization of perceived gestalten occurs in accordance with laws which are biologically determined; namely, the previous sensory motor action patterns developed in the individual.

"Visual motor patterns arise from motor behavior that is modified by the characteristics of the visual field" (Bender, 1938, p. 13). The visual field is organized about the primitive loop shape, since the baby's first experiences with form involve circular or near-circular objects such as the faces of family members. "There is a constant interplay or integration between the motor and sensory features which can never be separated, though one or the other may advance more

rapidly than the other in the maturation process and appear for a time to dominate any given stage in the evolution of the gestalt." (Bender, 1938, p. 13)

Bender illustrates her theory of the interaction of motor and perceptual processes by an analysis of young children's play. In this, large arm movements and whirling movements predominate. Early "drawings" by the young child consist of scribbles or loops which reflect these arm and whirling movements. At this stage "drawing" is "pure" motor expression.

Gradually, and as it were by accident, the child sees in a particular scribble or series of loops a resemblance to a real object. He then begins to experiment with the representation of form. Thus a child who has drawn a number of loops in the perseverative fashion common to early motor activity, may suddenly become aware that the loops resemble curly hair. Using the "curly hair" as a starting point, he may then proceed to add a larger circle for the human face, with smaller circles for the eyes, etc.

This is the beginning of true form perception, or of visual motor activity on a co-ordinated basis. By degrees perception works actively to modify motor behavior. For instance, in the example above, the

first thing the child must accomplish, if he is to succeed in representing a human face, is to know when to stop. Otherwise his loops and circles would be as before, perseverative and meaningless. The child who has learned when to stop has begun to learn the inhibition and control of movement. Once the child has reached this stage, form perception and its motor expression proceed apace, each modifying the other until integration is achieved.

It is not only the motor and perceptual aspects of functioning which are integrated, however, but these together with the other functions of the nervous system. Although Bender does not say so specifically, she implies that "central" processes mediate this integrated behavior. Now, since the integration of the nervous system depends upon maturation, measures of perceptual motor functioning, as measures of integration, will also be measures of the level of maturation and of total functioning.

Any sample of perceptual motor behavior could be postulated to reveal the level of integration. To Bender, visual motor behavior seemed the most useful for assessment purposes since it is so readily observable. It is the subject himself who records his

behavior in visual motor tasks. The outcome is there, plain for all to see. Hence the utility of a test of copying designs, Bender reasoned.

It is easily discernible from Bender's work that, just as she would not separate perceptual from motor functioning, neither would she divorce these in turn from "conceptual thinking," "intelligence," and "personality," as those terms are commonly interpreted. She suggested that the localization of the "gestalt function," that is, of the total integrative process, might be the parietal-occipital-temporal areas of the brain.

A less all-inclusive approach to this integration hypothesis is taken by Ross (1959). He reviews the stages of human development as those of (1) global responses; (2) differentiating responses; and (3) integrated responses or integration. What is integration? A function of the cerebral cortex, integration is "viewed as a physiologically mediated process which enables the organism to combine and relate discrete cues so that a unified response can occur" (Ross, 1959, p. 219). The "cues" may arise from the inner and/or the outer environments.

Prior to integration, differentiation takes place.

Without adequate differentiation there can be no integration but with adequate differentiation there may still be a breakdown in integration. Ross, like Bender, relates differentiation to the inhibition or control of movement.

The integration hypothesis would account for spatial dis-orientation, figure-ground disturbances, and other perceptual and conceptual difficulties, Ross believes. He holds that motor capacity may be intact, but if integration is defective, motor expression will be impaired.

Welford (1958) is interested in the "mechanism" of performance:

> There are two aspects of this mechanism, both of which it is important to keep in mind; firstly, the physical and chemical working of the various structures of the body; secondly, the way in which these interact with one another and the environment to produce behaviour. The first is essentially a matter of physiology, the second a matter of processes or systems involving relationships in time between physiological and environmental events, often expressed in the form of conceptual working models specifiable in mathematical terms. (Welford, 1958, p. 2)

Welford sees an interaction taking place between all the senses. Data reaching the organism via one modality are affected by data arriving through another channel. Hearing and vision may thus assist each other, to give but one example. The organization of such data,

moreover, involves all the information available to the individual at a given moment.

Welford believes that the "translation" process (the conversion of sensory perceptions into motor activity) is largely unconscious. It differentiates the data and then reintegrates them in a new pattern.

He sees perception as divisible into two aspects: (a) sensory discrimination; (b) more complex perception in which meaning is involved. He regards this division, however, as somewhat arbitrary.

Welford's approach to the study of human behavior is to take a complex performance and break it down into its essential features, rather along the lines of time-and-motion study in engineering. This is not essentially very different from the approach of the factor analysts, since all aim at identifying the basic components or processes in human functioning.

Kephart's (1960) theory of the perceptual-motor processes may be briefly summarized as follows: The primacy of motor functioning, not only in early development, but in all stages, levels, and types of functioning is assumed. Perception involves the making of movements, for example, the eyes "travel" around the sides of a square as it is seen. Sensory data provide

a form of energy which impinges on the organism and sets off neural activity. This neural activity, rather than the sensory data _per se_, constitutes the "input" in the functioning of the total human mechanism. All the factors present in the situation at the moment of perception may contribute to the perception and hence to the input.

All the data from input, and relevant data from past learning are "integrated," presumably by "associative" activity in the cortex. The resultant complex of data is then "scanned." The exact nature of the "scanning" process is rather obscure, but it seems to involve the conversion of the total data to a motor pattern for "output." The excess energy (such as kinaesthetic sensations) from output feeds back to input for modification of the entire cycle of processes as it begins once again.

Essential to integration is consistency of input. Here, adequate motor functioning of the organism is basic. Without co-ordinated eye movements, for example, input will be unstable and the subsequent processes will be impaired. Inadequate performance is the result.

Kephart considers that the way in which these processes operate is of vital importance to readiness

for school work. However, in spite of his emphasis on motor functioning and his insistence that the perceptual-motor processes be regarded as a unity, he in no way belittles the importance of traditional factors, such as "intelligence" and "motivation," in achievement.

Visual Motor Tasks and Their Relationships with other Variables

Visual motor capacity has been usually, but not exclusively, tested by means of drawing or copying tasks. These tasks have also been regarded as measures of integration (Bender, 1938; Welford, 1958; Ross, 1959), of maturation (Bender, 1938), and of intelligence (Binet and Simon, 1916; Wechsler, 1960). That they measure the attentiveness of the subject has been pointed out by many writers, from Binet and Simon (1916) to Wechsler (1960). Now, attentiveness may be considered to be a personality factor, or as an aspect of intelligence, depending upon the orientation of the research worker. A visual motor test may thus be looked upon as a personality test. Cronbach (1960), for example, includes the Bender Visual Motor Gestalt Test in the category of personality tests as a projective technique. Hal-

stead (1947) has suggested that in speeded tests, "set" may be an important variable. Hence in speeded visual motor tasks, "set" would have to be taken into account. A difficulty, then, arises in the interpretation of the results of visual motor tests. Just what is the given test measuring in a given individual at a given moment?

Townsend's (1951) study illustrates this difficulty in a striking way. He found the correlation between a test of form copying and the Kuhlmann-Anderson at the primary level to be .58. In view of the fact that the Kuhlmann-Anderson relies upon a considerable number of copying items at the primary level, and since his own copying test was highly reliable, Townsend expected the correlation to be much higher. It must be assumed that part of the explanation lay in the copying abilities required by the two tests being in some way essentially different. It is true that Townsend's test of copying forms demanded the ability to copy entire forms from the originals, while the Kuhlmann-Anderson demands only the completion of patterns with the assistance of background dots as guides.

A further disadvantage of many visual motor tests is that with the exception of those which are included

in standard scales of intelligence, few have been adequately standardized on normal populations and their reliability and validity remain unknown. Elaborate and unwieldy scoring systems, as employed by some investigators, present yet another problem in the use and interpretation of these tests.

Studies of growth in form perception, as measured by copying ability, are sometimes discrepant, as will be seen from a consideration of the age placement levels given for various tasks by the writers to follow.

In the 1937 Revision of the Stanford-Binet Scale (Terman and Merrill, 1937), a number of visual motor tasks occur. The age for which a given task is deemed appropriate is listed on page 38; first for Form L of this Scale, and later for Form M.

Inspection of Terman-Merrill's and Gesell's norms reveals that copying a cross and copying a diamond, respectively, have been placed at different age levels. Possibly the scoring standards used were different. The scoring standards on the Stanford-Binet are liberal, allowing for "passes" in cases of marginal success, and motor factors tend to be discounted. Gesell's long interest in the motor factors in development may have led him to give slightly more weight to motor factors than did Terman and Merrill. This, of

FORM L

Year	TASK
III	Copying a circle
III-6	Copying a cross
IV	Picture completion
V	Drawing a square
V	Picture completion
VII	Copying a diamond
IX	Memory for designs
XI	Memory for designs

FORM M

Year	TASK
III	Drawing a vertical stroke
IV-6	Picture completion
IX	Memory for designs
XII	Memory for designs

Gesell (1940) presents the following developmental schedule of ability to copy simple forms.

AGE	ABILITY
36 months	Copies a circle
48 months	Copies a cross
60 months	Copies a triangle
66 months	Copies a few letters
72 months	Copies a diamond

course, is a purely speculative explanation of the discrepancy.

Gesell (1928) placed the copying of a vertical line at the twenty-fourth to the thirtieth month, the copying of a horizontal line at the thirty-sixth to the fortieth month. Bender (1938) found that vertical lines were not copied accurately until the age of five or six. She was of the opinion that horizontal direction was acquired first. Gesell and Ames (1946), however, found that the vertical direction preceded the horizontal. They attributed this finding to the fact that there is an innate tendency for the young child to make vertical arm movements prior to side arm movements. Fabian (1945) considered the tendency to verticalize drawings from the horizontal as regressive.

Gesell and Ames (1946) found that the complexity of a figure affected the child's ability to reproduce direction correctly. This might explain why Bender's (1938) view that oblique lines are not copied correctly until the ages of nine to ten, is at variance with Gesell's placement of the diamond-copying task at the six-year-old level. Bender's Visual Motor Gestalt Test involves a rather difficult series of designs which, as she admits, even normal adults do not always copy corr-

ectly. Gesell's forms, on the contrary, are simple and symmetrical. Potter (1949) scored shapes copied by primary children for direction only. Her findings led her to suggest that the ability to reproduce direction accurately might be an aspect of intelligence. Fabian (1945) and others have shown that by the end of Grade III, any tendency of the normal child to produce directional errors in copying has virtually disappeared. The acquisition of correct directionality would thus seem to be a function both of mental age and of chronological age.

Research workers are generally agreed that accuracy in reproducing the details of figures increases with age, up to a point. Graham and Berman (1960) studied the changes in ability to copy forms in one hundred eight children between two and one-half and five years of age and reported a steady progression in accuracy of copying with age. Bender (1938) noted a rapid differentiation of form perception, as measured by her Visual Motor Gestalt Test, between age four and age seven. She drew attention to the fact that it is during these years that children are sent to school and are expected to learn to read and write. Townsend (1951) also noted rapid development with age up to age seven. After that it became irregular.

Benton (1955), and Wood and Shulman (1940) administered memory-for-designs tests to older subjects, age eight and up, and found improvement with age. Benton thought that a "plateau" was reached by about ages fourteen to fifteen. Wood and Shulman found the age increments to be only slight and there was considerable overlapping between age groups. The variability within age groups was greater than the variability between age groups.

What is the Relationship Between Copying Ability and Mental Age?

Murchison (1931) cites Herzberg (1926) as having obtained a correlation of .57 between mental age and scores on a test of copying symbols, for children of five years of age. Townsend (1951) found a correlation of .58 between mental age and a form copying test administered to two hundred eighty-seven children, age six years and one month; to nine years and three months. Analysis of the results at separate age levels forced him to conclude, however, that after the age of eight years, copying ability no longer plays a major role in intelligence.

Some reading readiness tests such as the Metro-

politan Readiness Test (1933) include sub-tests of copying ability. Since readiness tests are considered to measure the same function as general intelligence tests (Anastasi, 1954), it may be postulated that any "aptitude," such as copying ability, revealed by the readiness tests is fairly closely related to intelligence in the age range for which readiness tests are appropriate. That this relationship holds throughout the primary years is indicated by the inclusion of a number of copying items in the Kuhlmann-Anderson Intelligence Tests (1927) at the Grades I to III levels. The Kuhlmann-Anderson Tests are highly reliable and of adequate validity (Thorndike and Hagen, 1960, p. 549), hence it may be safely assumed that copying ability as measured by these tests is a function of intelligence.

Among older children Benton found his Visual Retention Test (1955) scores correlated about .70 with scores on standard intelligence tests.

Wood and Shulman (1940) reported that their memory-for-designs test given to over one thousand children aged eight and one-half years to seventeen and one-half years differentiated only the extremes of the ability range. This result may in part have been due to the very lenient scoring system employed,

which made the range of possible scores too narrow.

Townsend (1951) found that copying ability, as measured by his test, ceased to be a function of mental age after the age of eight years. He wondered how it functioned in adulthood. He therefore administered the copying test to a group of college students (N = 33) and discovered that although the students as a group made fewer errors than his primary grade subjects, some of the students were unable to reproduce all aspects of the designs. He was inclined to believe, in view of this finding, that copying ability is unstable after a mental age of eight, and that it may be affected by individual factors such as personality. However, his results may have been partly a function of the nature of the form copying test itself.

Miller (1938) reported a very different outcome. He administered a test of copying simple geometrical forms to nine hundred children from age four to twelve years. The correlations between scores on this test and scores on standard intelligence tests ranged from .69 (Grades V to VII) to .75 (Grade I). Miller thought that such a test, if standardized, would be very useful, not as a substitute for more elaborate tests, but for rapid, tentative classification.

Hollingworth (1923) suggested that research might eventually show that copying ability is related to intelligence, although she had observed that some bright children do not draw well, while on the other hand, a child of rather limited intelligence occasionally shows considerable facility (but not creativity) in drawing.

Burt (1922) described the relationship of drawing ability to intelligence as non-linear. While bright children, as a group, demonstrated ability in drawing; drawing ability did not necessarily indicate intelligence, he found.

Goodenough (1926) correlated the scores on her Draw a Man Test with scores on the Stanford-Binet. She reported a correlation of .763. Her subjects ranged from age four to twelve years.

What is the Relationship Between Form Perception and Copying Ability?

Kephart (1960) has suggested that copying ability yields a "true" measure of form perception, since it reveals the degrees of differentiation and integration that have been achieved by the individual. Bender (1938) criticized the Street Gestalt Test as a measure of form perception because it did not involve the reproduction

of form and hence could not assess the integrated functioning of the subject. Those views raise two interesting questions:

1. To what extent is copying ability related to form perception as measured in the usual way by tests of visual discrimination?

2. To what extent is copying ability related to measures of motor ability?

Townsend (1951), already cited above, studied the interrelationships of form perception, copying ability, and motor abilities. Each item in his test of form perception required the subjects to find, among a group of four designs, the one design which was identical with a given master design. He gave a series of motor tests, including a measure of tapping speed. The copying test was administered individually. His subjects were two hundred eighty-seven children ranging in age from six years and one month, to nine years and three months, in the first three grades of an urban school system.

A correlation of .60 was obtained between the copying test scores and the form perception test scores. When mental age was partialled out the correlation was .42. The correlation of the copying test scores with

the scores on the motor battery was .52. When mental age was partialled out the correlation was .19. Since the correlation of the copying test scores with the form perception test scores was significantly higher than the correlation between the scores on the copying tests and scores on the motor battery, Townsend concluded that copying ability was more intimately related to form perception than to motor ability. Moreover, his results showed clearly that the relationship between copying ability and form perception was independent of mental age.

What is the Relationship of Visual Motor Skills to Achievement, Specifically in Reading?

Kephart (1960) reports that Lowder (1956), Robinson *et al*. (1958), and Goins (1958) obtained evidence of a significant relationship between form copying and achievement at the primary grade level.

Petty (1939) obtained the following correlations in a study of her Grade I pupils: She concluded that, at

Reading achievement with mental age	.52
Reading achievement with I.Q.	.48
Reading achievement with a drawing test	.48

the Grade I level a drawing test was as good a predictor of achievement as was the intelligence quotient. She did not report on the relationship of the drawing test to the intelligence quotient or mental age, however.

Goodenough (1926) found that scores on her Draw a Man Test correlated .44 with achievement in the primary grades. After that the correlation was non-significant.

The coding sub-test on the Wechsler Intelligence Scale for Children (Wechsler, 1949b) is regarded by Ross (1958, p. 222) as a measure of "integration," and by Welford (1958, p. 129) as a measure of the "translation" process. Coding, at least for some subjects, is more than a copying test. It is postulated that for certain individuals this sub-test taps a "factor" such as rapidity of association or facility in learning new material. Possibly this factor is evoked only in the better integrated subjects. Children with faulty integration seem to obtain low scores on this test (Ross, 1958, p. 229). Be that as it may, Coding obviously constitutes a speeded visual motor test.

Dockrell (1960) found that a group of retarded readers, eight to fifteen years of age and of "average" ability, made significantly lower scores on this test

than on the other sub-tests of the Wechsler Intelligence Scale for Children. The finding is suggestive.

Certain Other Considerations in Visual Motor Tasks

Oleron (1957) considers that "fluency," as measured by the total number of words written in a given time, is not a matter of motor ability but that it involves a "central" capacity to deal with words. In this connection a factor analysis of a battery of tests given to adults by Mangan (1960) is worthy of attention. Mangan found that a speeded test of paragraph copying had a significant loading of .42 on the "g + v: ed" factor (Vernon, 1956, p. 144). This test of paragraph copying also had a loading of .60 on the "motor speed" factor used in the analysis as a reference factor. The test had no loading on Thurstone's P. Thus a speeded test of paragraph copying at the adult level may be presumed to reflect general ability, past training and experience, and motor speed.

That certain visual motor tasks are not liked by adults is a view put forward by Weisenburg, *et al.* (1936), who found that drawing and digit-symbol substitution tests did not appeal to their subjects and were of little value in discriminating among these normal adults.

Weisenburg _et al_. felt such tests were very useful, however, when they were dealing with cases of mental deterioration.

Both Bender (1938) and Townsend (1951) reported that some normal adults did not perform well on their tests. Both investigators used the Bender Visual Motor Gestalt Test (Bender, 1938). Townsend used some simple geometric forms as well. The Bender Test was standardized on subjects from four to eleven years of age. In the light of the experiences of Weisenburg _et al_., it seems highly possible that the copying of forms, a test designed for children, was a task not calculated to prove attractive to certain adult personalities.

It is also possible that some children above the primary grade level may react unfavorably to a form copying test, which to them may appear as irrelevant and uninteresting. Furthermore, as Goodenough (1926) has pointed out, as the child matures he tends to become critical of his drawing production. This may lead certain older children and adults to "reject" tasks requiring drawing and to perform in a careless, indifferent way, with resultant low scores, on a test of this nature. For this reason, apart from such fundamental questions as the doubtful reliabilities and validities of visual

motor tests, it would seem that the results of such tests must be interpreted with great caution, and only when adequate information obtained with more reliable instruments is available about the subject or subjects to whom the visual motor tests have been administered.

Summary

There appears to be a steady growth in visual motor ability, as measured by copying and representative drawing up to age seven. While increments appear up to adolescence, the curve of development seems to be very irregular beyond the age of seven. It may possibly be affected by personality and other factors at levels above age seven. A close relationship between copying and/or drawing ability and intelligence may be expected up to a mental age of eight; after that the relationship observed may be inconsistent. A substantial relationship between visual motor ability and reading achievement may be expected at the primary grade level. Once this level is passed, the relationship, if any, is presumed to be slight. Possibly other factors soon become more important than visual motor skill as determiners of reading achievement. Certain speeded, meaningful tests of visual motor ability may, however, reveal relationships with both reading

achievement and intelligence in other subjects.

In light of this review of the literature the hypotheses to be found in Chapter I of this study were formulated.

CHAPTER III

EXPERIMENTAL DESIGN

I. THE TESTS

The centre of interest in this study is the relationship of visual motor skills, as measured by tests of copying abilities, to reading achievement, as measured by a standardized test. A first concern was the choice of materials for the copying tests. Since a review of the literature had indicated that speed might be crucial in certain perceptual and motor tasks, it was decided to employ speeded measures of the visual motor tasks under investigation.

As a speeded test of paragraph or word copying was required, an obvious choice was the Copying Text sub-test from the Monroe-Sherman Group Diagnostic Reading Aptitude and Achievement Tests. No information was available on the reliabilities or validities of these tests. Only one and one-half minutes is allowed for the Copying Text test in the Monroe-Sherman battery. It was felt that this was too short a test to yield a satisfactory reliability, hence a parallel test was devised. A passage at a level of difficulty similar to that of the Monroe-Sherman Copying Text test was

selected for this purpose. This passage was taken from Theisen and Bond's (1945) "Journeys in Storyland," page 112. The Copying Text test from the Monroe-Sherman battery was then designated as "Copying Text I," and the passage from Theisen and Bond as "Copying Text II." These two tests taken together, comprised a single measure of word copying, "Copying Text Total." The two tests will be found in Appendix A under their respective titles.

The scoring of the Copying Text tests followed the instructions given in the manual accompanying the Monroe-Sherman battery. One point was awarded for each word correctly copied within the one and one-half minutes time limit.

The selection of a form copying test proved more difficult, since the standard tests of form copying, the Bender Visual Motor Gestalt Test (Bender, 1938), and the Benton Revised Visual Retention Test (Benton, 1955), are designed for administration as individual, untimed tests. The only solution was to devise a new test using material employed in other investigations, and supplemented where necessary by fresh material.

Designs were borrowed from the following sources (but were not, as used in the present investigation,

identical in every respect with the originals):

1. The Revised Visual Retention Test (Benton, 1955).
2. The Gates Associative Tests (Gates, date unknown).
3. Krise's reversible figures (Krise, 1952).
4. The Ellis Visual Designs (Bronner and Healy, 1927).
5. "The Slow Learner in the Classroom" (Kephart, 1960).

In addition, several new designs were included. The total number of designs used was twenty. These designs will be found in Appendix B under the heading, "Form Copying."

An effort was made to present the designs in order of difficulty, but since the test was not standardized, this order, determined by subjective judgment, may be somewhat arbitrary, especially in respect to the more difficult designs. The latter were included for the purpose of providing enough "ceiling" for the test.

The designs were not numbered, as numbering would have taken up too much space. A blank space, of the same size as the "box" containing each design, was provided beside the design for copying that design.

Developing a method of scoring the Form Copying test presented a problem, too, since it had been decided

at the outset that the scoring scheme should not be too elaborate. After considerable study of scoring criteria employed by other investigators, the following scheme was finally adopted:

Each copy of a design was scored on a four-point basis, one point being given for meeting all the requirements of a given criterion. The maximum total score possible was thus 80. There were four criteria, as below:

A. Gestalt. The essential form of the design had to be reproduced without conspicuous distortion in the slopes of the lines. Thus if the diamond-shaped figures were copied as squares, they were scored zero. All rotations from the given planes were unacceptable.

B. Components. All components present and without additions.

C. Relationships and Proportions. The relationships and proportions of the original had to be maintained in the copy.

D. Motor Control. Lines reasonably firm, not tremulous, "sketchy," or "re-worked," and without needless breaks and joins. Angles sharply defined, not "filled in" with heavy lines to conceal a lack of sharpness.

The measure of reading achievement chosen was The Gates Reading Survey, Form 3 (Gates, 1958). This Test has been described as having "satisfactory reliabilities throughout the range of grades" (Thorndike and Hagen, 1961, p. 579). The scoring system applied to it has the advantage of including a correction for guessing. The test is divided into three sub-tests, namely, a Speed and Accuracy Test, a Reading Vocabulary Test, and a Level of Comprehension Test. The first of these is a speeded test with a differential time-allowance for lower and higher grades; six minutes is allowed for Grades III, IV, and V; four minutes for Grades VI to X. Twenty minutes, more or less, according to the needs of the pupils, is allowed for each of the other two tests.

The Co-operative School and College Ability Tests (1955) were selected as the measure of mental ability for the study. These tests, popularly called SCAT, will be so named hereunder. They have been carefully normed on a large representative sample of United States pupils. Reliabilities for the verbal scores are at least .92 for all grades, and validity coefficients, predicting school achievement, as high as .70 have been reported (Davis, 1959). Since the pupils in the present study had completed Grade III and Grade V, they were considered as

Grade IV and Grade VI pupils for the purpose of selecting the appropriate Levels of SCAT to be used. Level 5, Form A, was administered to the Grade III group; and Level 4, Form A, to the Grade VI group.

SCAT yields two separate scores, a Quantitative Score, and a Verbal Score, as it is divided into two main sections of this nature. Only the Verbal section was used in the present instance. That this procedure was justified seemed to be indicated by the fact that the intercorrelations of the Verbal and Quantitative scores are very high,,especially at the grade levels concerned in this study (Fowler, 1959), p. 455). An important feature of the SCAT Verbal section is that, although it is timed, it is relatively unspeeded. As the authors of the test have pointed out:

"It was the feeling of the educators who were responsible for the construction of SCAT that a test of verbal skill should not provide an advantage for the fast-responding student, because rate is a relatively unimportant part of verbal skill. . . .

The results of the analyses of the verbal sections indicate that speed plays a substantial but not major role in determining scores." (Co-operative School and College Ability Tests, Technical Manual, p. 12).

The SCAT raw scores may be converted and interpreted in terms of a percentile band for each individual student. Group scores cannot be interpreted in this way, however. Hence the mean performance of each group in the present study can only be reported in raw score form.

II. THE SAMPLE

Since it was postulated that form perception would show a less close relationship with reading achievement at levels above the primary grades, than in the primary grades, pupils at both levels were sought for comparative purposes. The subjects of this investigation were fifty-three Grade III and sixty-two Grade V pupils in an urban school. Each group contained two parallel rooms at the same grade level and may be regarded as representing the range of ability to be found in typical classrooms at these grade levels. The pupils, at the time of testing, had completed the work of their respective grades.

III. THE PROCEDURE

The testing took place in the latter half of June, 1961. Each testing session was scheduled to occupy an entire half-day for each grade. The Grade III pupils were

tested in the morning, and the Grade V pupils in the afternoon of the Tuesday and Thursday of the third week of June. Testing was arranged so that the customary morning and afternoon recesses could be observed. The order of administration of the tests was as follows:

Name of Test

1. The Gates Reading Survey
2. Copying Text I
3. Form Copying
4. SCAT Verbal
5. Copying Text II

The time-limits for the standardized tests were observed in accordance with the instructions given in the manuals accompanying these tests. The time-limit for each Copying Text Test was one and one-half minutes. Eight minutes was allowed for the Form Copying Test at the Grade III level, six minutes at the Grade V level.

IV. THE STATISTICAL TREATMENT OF THE DATA

Reliabilities were established for the Copying Text Test and the Form Copying Test, respectively. The re-test reliability of the Copying Text (coefficient of correlation between Copying Text I and Copying Text II) was determined at both the Grade III and Grade V levels.

A measure of the internal consistency of the Form Copying Test was obtained by applying the Kuder-Richardson Formula 21 (Ferguson, 1959, p. 282) to the data from this test. Inter-rater reliability for the Form Copying Test was determined by computing the correlation coefficient between the scores obtained by one of the Grade III classes (N = 24) when their performance was rated by the writer, and the scores obtained when performance was rated by an independent judge according to the given criteria.

Intercorrelations of the major variables in the study were computed. These were Pearson-product-moment correlations (Ferguson, 1959, p. 92). The obtained correlations were first calculated "by hand" and later run on Computer LGP 30 in the Computer Centre of the University of Alberta.

Partial correlations to remove the effects of mental ability, form copying ability, and word copying ability, in turn, on the intercorrelations were obtained. Two partial correlations, to eliminate the effects of chronological age, were also calculated.

In order to discover whether the experimental tests had value, over and above that of a verbal intelligence test, in predicting reading achievement, multiple corre-

lations including the effects of the SCAT Verbal, Form Copying, and Copying Text, were found for each grade level. These multiple correlations were obtained by Aitken's (1937) method of pivotal condensation (Ferguson, 1959, pp. 298-301).

CHAPTER IV

THE FINDINGS

Reliabilities of the Form Copying and Copying Text Test

The measure of internal consistency (Kuder-Richardson Formula 21) of the Form Copying Test was .55. Inter-rater reliability was .72. Since these are relatively low reliabilities, their effect would be to reduce the correlations of the Form Copying scores with other variables. Hence the obtained correlations must be interpreted with caution. This caution also applies to correlations of the Copying Text scores with other variables. The re-test reliability of the Copying Text Test at the Grade III level was .669; at the Grade V level it was .595.

The raw scores on all the tests used in the investigation, together with the means and standard deviations for the Grade III group will be found in Table I of Appendix C. Table II of Appendix C shows the corresponding data for the Grade V group.

Standard Deviations of all the Variables Employed

The standard deviations of the variables employed, except in the case of the Gates Total scores, tend to be

low, and indicate the relatively poor discriminative value of the tests for the subjects of this study. The restricted range of results thus apparent would have the effect of attenuating the interrelationships of all the variables studied.

Mean Scores, Distributions of Scores, and Normative Comparisons

The mean scores on the SCAT Verbal cannot be interpreted in terms of group norms for the standardization population, as SCAT only permits the interpretation of individual scores. Hence the mean raw scores of the two groups in the present sample are reported without a normative comparison. These scores will be found in Appendix C, Table I, for the Grade III pupils; and in Appendix C, Table II for the Grade V pupils.

Tables showing the grade equivalents of the mean raw scores on the Gates Reading Survey are given in Appendix D, Tables I and II. These results indicate that the pupils in both groups were up to standard in reading achievement according to the norms for American children given in the manual accompanying the Gates Survey. Table I on page 64, shows the distribution of scores on the Copying Text Total for the Grade III pupils

TABLE I

DISTRIBUTION OF SCORES ON COPYING TEXT TOTAL, GRADE III

Class Interval Raw Scores	Tally	Frequency
46 - 48	I	1
43 - 45		0
40 - 42	IIIII	5
37 - 39	II	2
34 - 36	IIII	4
31 - 33	IIIIIIIII	9
28 - 30	IIIIII	6
25 - 27	IIIIIIIIIII	11
22 - 24	IIIIIII	7
19 - 21	III	3
16 - 18	II	2
13 - 15		0
10 - 12	III	3
Total		53

As regards the Copying Text Test, norms were available only for Copying Text I, which was taken from the Monroe-Sherman Group Diagnostic Reading Aptitude and Achievement Tests. According to the Monroe-Sherman norms, the mean score (13.04) obtained by the Grade III pupils, with a mean chronological age of 109 months, would fall between the 10th and 20th percentiles for nine-year-olds.

Table II, page 66, shows the distribution of scores on Copying Test Total for Grade V pupils. The distribution shows a tendency towards positive skewness, with the scores piling up at the lower end.

The mean score (24.5) obtained by the Grade V pupils, with a mean chronological age of 136 months, stands between the 20th and 30th percentiles for eleven-year-olds. Scores falling below the 25th percentile on this test are regarded as below average.

Table III, page 67, shows the distribution of scores on Form Copying for the Grade III pupils.

Table IV, page 68, shows the distribution of scores on Form Copying for the sixty-two Grade V pupils.

It will be observed that while the distribution of scores on Form Copying shows a normal trend at the Grade III level, at the Grade V level there is a

TABLE II

DISTRIBUTION OF SCORES ON COPYING TEXT TOTAL, GRADE V

Class Interval Raw Scores	Tally	Frequency
71 - 73	II	2
68 - 70	I	1
65 - 67	II	2
62 - 64	I	1
59 - 61		0
56 - 58	I	1
53 - 55	IIIIIIIIIIIIIIIIII	18
50 - 50	IIIIIII	7
47 - 49	IIIIIIIII	9
44 - 46	IIIIIII	7
41 - 43	IIIIIII	7
38 - 40	I	1
35 - 37	IIIII	5
32 - 34	I	1
Total		62

TABLE III

DISTRIBUTION OF SCORES ON FORM COPYING
GRADE III

Class Interval Raw Scores	Tally	Frequency
42 - 44	I	1
39 - 41	II	2
36 - 38		0
33 - 35	IIIIII	6
30 - 32	IIIIIIIII	9
27 - 29	IIIIIIIIIIIII	13
24 - 26	IIIIIIII	8
21 - 23	IIIIII	6
18 - 20	IIII	4
15 - 17	II	2
12 - 14	II	2
Total		53

TABLE IV

DISTRIBUTION OF SCORES ON FORM COPYING
GRADE V

Class Interval Raw Scores	Tally	Frequency
51 - 53	I	1
48 - 50	I	1
45 - 47	I	1
42 - 44	I	1
39 - 41	IIII	4
36 - 38	IIIIIIIIII	10
33 - 35	IIIIIIIIIII	11
30 - 32	IIIIIIII	8
27 - 29	IIIIIIIII	9
24 - 26	IIIIIIIIIIII	12
21 - 23	II	2
18 - 20		0
16 - 17	I	1
13 - 15		0
10 0 12	I	1
Total		62

tendency towards bimodality. The "answer sheets" of the Grade V pupils showed two major types of response. One group of students completed all the designs within the time-limit, with some inaccuracies doubtless due to haste; another group worked very carefully and accurately and obtained high scores on those designs which they completed, but they did not attempt all the designs.

The Relationship of Form Copying to Reading Achievement

Scattergrams of scores on the Form Copying Test and scores on the Gates Total were plotted to see if there was a curvilinear relationship between them. The scattergrams showed no consistent tendency for high scores on Form Copying to be associated with high scores on the Gates Total, or for low scores on Form Copying to be accompanied by low scores on the Gates Total.

The same procedure was carried out with the scores on the Gates Speed of Reading Test and the Form Copying scores, with similar results. While there was some tendency for scores on Form Copying and on reading achievement, as measured either by the Gates Total or

the Gates Speed of Reading Test, to parallel each other in the middle ranges of the groups, children who were markedly low or high on Form Copying were not necessarily low or high, respectively, in reading achievement, and vice-versa.

The Form Copying Test used in this study would not, therefore, seem to have value as an instrument for the identification of poor or exceptionally good readers among typical subjects.

Intercorrelations and Partial Correlations

The intercorrelations of the major variables are shown in Table V, page 71, and Table VI, page 72. Table V presents the intercorrelations for the Grade III pupils; and Table VI the intercorrelations for the Grade V pupils.

The partial correlations, partialling out the effects in turn, of SCAT, the Copying Text Total, Form Copying, and Chronological Age on certain intercorrelations, are presented in Table VII, page 73, and Table VIII, page 74. Table VII refers to the Grade III pupils and Table VIII refers to the Grade V pupils.

TABLE V

MATRIX OF INTERCORRELATIONS OF ALL VARIABLES
GRADE III

N = 53

	1	2	3	4	5	6	7	8
1. Copying Text Total	1	.526**	.354**	.349**	.467**	-.010	.544**	.241*
2. Gates Speed of Reading		1	.484**	.573**	.760**	-.174	.622**	.364**
3. Gates Vocabulary			1	.584**	.863**	-.061	.681**	.319*
4. Gates Comprehension				1	.870**	.003	.705**	.146
5. Gates Total					1	-.077	.815**	.317*
6. Chronological Age						1	-.210	.073
7. Scat Verbal							1	.447**
8. Form Copying								1

*Significant at the .05 level, one-tailed test.

**Significant at the .01 level, one-tailed test.

TABLE VI

MATRIX OF INTERCORRELATIONS OF ALL VARIABLES
GRADE V

N = 62

	1	2	3	4	5	6	7	8
1. Copying Text Total	1	.460**	.202	.224**	.299**	.094	.234*	.020
2. Gates Speed of Reading		1	.640**	.595**	.791**	-.256*	.726**	.164
3. Gates Vocabulary			1	.714**	.933**	-.385**	.828**	.230*
4. Gates Comprehension				1	.886**	-.434**	.777**	.169
5. Gates Total					1	-.422**	.890**	.221*
6. Chronological Age						1	-.354**	.018
7. Scat Verbal							1	.281*
8. Form Copying								1

*Significant at the .05 level, one-tailed test.

**Significant at the .01 level, one-tailed test.

TABLE VII

PARTIAL CORRELATIONS, GRADE III

N = 53	$r_{12.3}$	r_{12}
Form Copying and Gates Tests; SCAT Removed		
Form Copying and Gates Speed	.101	.364**
Form Copying and Gates Vocabulary	.025	.319*
Form Copying and Gates Comprehension	-.307*	.146
Form Copying and Gates Total	-.103	.317*
Form Copying and Gates Total; Chronological Age Removed	.325**	.317*
SCAT and Gates Tests; Form Copying Removed		
SCAT and Gates Speed	.599**	.662**
SCAT and Gates Vocabulary	.636**	.681**
SCAT and Gates Comprehension	.723**	.705**
SCAT and Gates Total	.787**	.815**
Copying Text and Gates Tests; Form Copying Removed		
Copying Text and Gates Speed	.485**	.526**
Copying Text and Gates Vocabulary	.301*	.354**
Copying Text and Gates Comprehension	.326**	.349**
Copying Text and Gates Total	.424**	.467**
Copying Text and Gates Tests; SCAT Removed		
Copying Text and Gates Speed	.263*	.526**
Copying Text and Gates Vocabulary	-.027	.354**
Copying Text and Gates Comprehension	-.058	.349**
Copying Text and Gates Total	.049	.467**
SCAT and Gates Tests; Copying Text Removed		
SCAT and Gates Speed	.528**	.662**
SCAT and Gates Vocabulary	.623**	.681**
SCAT and Gates Comprehension	.662**	.705**
SCAT and Gates Total	.756**	.815**

*Significant at the .05 level, one-tailed test.

**Significant at the .01 level, one-tailed test.

TABLE VIII

PARTIAL CORRELATIONS, GRADE V

N = 62	$r_{12.3}$	r_{12}
Form Copying and Gates Tests; SCAT Removed		
Form Copying and Gates Speed	-.062	.164
Form Copying and Gates Vocabulary	-.003	.230*
Form Copying and Gates Comprehension	-.081	.169
Form Copying and Gates Total	-.064	.221*
Form Copying and Gates Total; Chronological Age Removed	.252*	.221*
SCAT and Gates Tests; Form Copying Removed		
SCAT and Gates Speed	.719**	.726**
SCAT and Gates Vocabulary	.817**	.828**
SCAT and Gates Comprehension	.771**	.777**
SCAT and Gates Total	.885**	.890**
Copying Text and Gates Tests; Form Copying Removed		
Copying Text and Gates Speed	.469**	.460**
Copying Text and Gates Vocabulary	.212*	.202
Copying Text and Gates Comprehension	.231*	.224*
Copying Text and Gates Total	.311**	.299**
Copying Text and Gates Tests; SCAT Removed		
Copying Text and Gates Speed	.433**	.460**
Copying Text and Gates Vocabulary	.016	.202
Copying Text and Gates Comprehension	.069	.224*
Copying Text and Gates Total	.203	.299**
SCAT and Gates Tests; Copying Text Removed		
SCAT and Gates Speed	.716**	.726**
SCAT and Gates Vocabulary	.821**	.828**
SCAT and Gates Comprehension	.768**	.777**
SCAT and Gates Total	.885**	.890**

*Significant at the .05 level, one-tailed test.

**Significant at the .01 level, one-tailed test.

Hypothesis One

The Form Copying Test correlated .317 with the Gates Total for the Grade III pupils, and .221 for the Grade III pupils. Both correlations were significant at the .05 level.

When mental ability was partialled out, however, the above correlations became -.103 and -.064, respectively. Neither of these partial correlations was significantly different from zero. This finding supported Hypothesis One, which stated that when mental ability, as assessed by a verbal intelligence test, is partialled out, the relationship between a speeded test of form copying and a measure of total reading achievement will not be significantly different from zero at the Grade III and Grade V levels.

The correlations of Form Copying with the measures of reading achievement tended to be somewhat higher for the Grade III pupils than for the Grade V pupils. However, this tendency was not consistent, for example, the correlation of Form Copying with Comprehension was .169 in Grade V, and .146 in Grade III. Since all the correlations of Form Copying with the measures of reading achievement were small, the dif-

ferences between corresponding correlations at the two grade levels were not significant.

The correlations of Form Copying with chronological age were insignificant at both grade levels. When chronological age was held constant, the correlation of the Form Copying scores with the Gates Total scores was raised from .317 to .325 for the Grade III pupils, and from .221 to .252 for the Grade V pupils. Thus, partialling out chronological age raised the correlations only slightly.

Hypothesis Two

The correlation of the Copying Text Total scores with the Gates Total scores was .467 for the Grade III pupils and .299 for the Grade V pupils. When mental ability, as measured by SCAT, was partialled out, these correlations were reduced to .049 and .203, respectively. Hypothesis Two, which stated that when mental ability is held constant, there will be a positive but small relationship between a speeded word copying test and a measure of total reading achievement at the Grade III and Grade V levels, was thus upheld at the Grade V level, but not at the Grade III level.

Hypothesis Three

The correlations of the Copying Text Total with Speed of Reading were substantial: .526 for Grade III, and .460 for Grade V. When SCAT was held constant, the Copying Text Total correlated .263 with Speed of Reading for Grade III. This correlation was significant at the .05 level. The corresponding partial correlation for Grade V was .433, significant at the .01 level. These findings supported Hypothsis Three, which stated that when mental ability is partialled out, there will be a significant relationship between a speeded test of word copying and a measure of speed of reading, at the Grade III and Grade V levels.

The correlations of the Copying Text with the other measures of reading achievement, once mental ability was held constant, were not significant.

In Grade III, the difference between the correlation of the Copying Text Total with Speed of Reading (.526), and the correlation of the Copying Text Total with Vocabulary (.354) was not significant: $t = 1.388$, p is less than .20.

Again, in Grade III, the difference between the correlation of the Copying Text Total with Speed of Reading (.526), and the correlation of the Copying Text

Total with Comprehension (.349) was not significant: $t = 1.624$; p falls between .10 and .20.

At the Grade V level the correlation of the Copying Text with Speed of Reading was .460, considerably higher than the correlation of the Copying Text with Vocabulary (.202). The difference was significant at the .02 level: $t = 2.665$. For df 59, a "t" of 2.388 is required for significance at the .02 level.

Similarly, in Grade V, the correlation of the Copying Text with Speed of Reading (.460) was higher than the correlation of the Copying Text with Comprehension (.224). The difference was significant at the .05 level: $t = 2.231$. For df 59, a "t" of 2.001 is required for significance at the .05 level.

Hypothesis Four

The Form Copying Test showed a marked correlation (.447) with SCAT for the Grade III pupils. This correlation was significant at the .01 level. The corresponding correlation for the Grade V group was .281, significant at the .05 level. These two correlations supported Hypothesis Four, which stated that from copying will show a significant relationship with a measure of mental ability at the Grade III and Grade V levels.

The correlation of Form Copying with SCAT in Grade III (.447) was higher than in Grade V (.281), but the difference between grades was not significant: $z = 1.00$; $p = .40$.

The Relationship of Form Copying to Word Copying

The correlation (.241) of Form Copying with the Copying Text Total for Grade III was significant at the .05 level. At the Grade V level the correlation was .020. The difference between grades was not significant: $z = 1.36$; $p = .18$.

Word Copying versus Form Copying as a Predictor of Reading Achievement

In grade III, the correlation of the Copying Text Total with Speed of Reading (.526) was higher than the correlation of Form Copying with Speed of Reading (.364). The difference was not significant, however: $t = 1.14$. For df 50, a "t" of 2.010 is required for significance at the .05 level.

For Grade V, the correlation of the Copying Text Total with Speed of Reading (.460) was also higher than the correlation of Form Copying with Speed of Reading (.164), but the difference was not significant: $t = 1.826$.

For df 59, a "t" of 2.001 is required for significance at the .05 level. The probability of the obtained "t" falls between the .05 and .10 levels.

Multiple Correlation Coefficients

Multiple correlation coefficients including the effects of SCAT, Form Copying, and the Copying Text Total in predicting the Gates Total score, were computed. The obtained coefficients, .824 for Grade III and .895 for Grade V, were only very slightly higher than the correlations of the single predictor, SCAT, with the Gates Total, namely, .815 for Grade III, and .890 for Grade V.

Other Findings

The correlation of the Copying Text Total with SCAT for Grade III was .544, significant at the .01 level. At the Grade V level the corresponding correlation was .234, significant at the .05 level. The difference between the correlations fell just short of significance at the .05 level: $z = 1.93$; $p - .054$.

Substantial or high correlations of SCAT with the measures of reading achievement were obtained. When the effects of Form Copying, and of the Copying

Text Total were partialled out, in turn, the relationships remained as before, substantial or high.

The intercorrelations of the Gates sub-tests ranged from substantial to high for the subjects of this experiment.

CHAPTER V

CONCLUSIONS

Relatively few firm conclusions could be drawn from this study. The inconclusiveness of many of the findings is in part an outcome of the refined statistical techniques applied to the data. Had partial correlations not been obtained, as has so often been the case in previous studies of the relationship of copying ability to other variables, the existence of very definite relationships between aspects of copying ability and aspects of reading achievement could have been readily demonstrated, as inspection of the matrices presenting the original intercorrelations will indicate.

The following conclusions can, however, be made in light of the findings:

1. Hypothesis One was supported for both groups of subjects in the study.

2. Hypothesis Two was upheld for the Grade V pupils, but not for the Grade III pupils.

3. Hypothesis Three was upheld at both grade levels.

4. Hypothesis Four was upheld at both grade levels.

5. Form copying was significantly related to word copying at the Grade III level, but at the Grade V level the relationship was negligible.

6. When mental ability was held constant, form copying was not positively and significantly correlated with any of the measures of reading achievement at either grade level.

7. SCAT proved to be effective predictor of all the aspects of reading achievement considered in this study, namely, speed of reading, reading vocabulary, and reading comprehension.

CHAPTER VI

DISCUSSION AND IMPLICATIONS

The negative or zero correlations of chronological age with the achievement variables in this study are in accord with the findings of other investigations in which the subjects were selected, as here, on a grade-placement rather than on an age basis. The zero correlations of the Form Copying scores with chronological age are, however, somewhat surprising in view of previous studies of the ability to reproduce designs either by copying or from memory, although one investigator (Townsend, 1951) did find that, after age seven, development in form copying ability proceeded erratically.

The zero correlations of Form Copying with chronological age in the present study may be in part due to the low reliability of the Form Copying Test, and in part to the fact that Form Copying was related to mental ability as assessed by SCAT, the latter in turn being negatively related to age.

The finding of no difference between the correlations of Form Copying with SCAT at the Grade III and Grade V levels suggests that form perception, as

measured by copying ability, is as closely related to general verbal ability at the Grade V level as it is at the Grade III level.

Allowing for the moderate reliability of the Form Copying Test, the fact that the removal of the effects of Form Copying from the correlations of the SCAT scores with the scores on the reading achievement measures resulted in lower correlations in all cases but one, suggests that form copying may involve a factor other than intelligence, possibly a specific perceptual factor, but that this factor is slight.

Although the difference between the correlations of Form Copying with the measures of reading achievement for the two grade levels were not significant, the correlations at the Grade III level showed a tendency to be higher than those at the Grade V level. Possibly form perception, as measured by copying ability, is more closely associated with reading achievement at the Grade III level than at the Grade V level. This would seem logical, for in Grade III the child is still in the process of acquiring the mechanics of reading which probably depend, in the first instance, on the degree of his form perception. Later, teaching and experience may sup-

plement any deficiency in form perception, so that the relationship between form perception and reading skill may be less marked in the higher grades.

Again, although the difference was not statistically significant, the relationship between Form Copying and the Copying Text Test tended to be higher for the Grade III pupils than for the Grade V pupils. With regard to this point the opinion may be hazarded that at lower grade levels word copying and form copying draw on the same basic ability, while at the higher grade levels a gap may appear between word copying, a trained skill; and form copying, an untrained skill.

At the Grade III level a trend was shown for the tests involving a high degree of speed, the Copying Text and Speed of Reading, to be more closely related to each other than the Copying Text was with the relatively unspeeded Vocabulary and Comprehension Tests. At the Grade V level, this trend became statistically significant. The finding might be interpreted thus: at the Grade III level speed of perception is still a factor in the course of development, by Grade V it is an established factor. Moreover, the significantly higher correlations of the Copying Text

Total with Speed of Reading than with Vocabulary or Comprehension prompts the suggestion that there are factors common to the first two tests. Apart from speed, accuracy of word recognition is probably involved.

In both groups of subjects there was a tendency for the Copying Text to yield higher correlations with Speed of Reading than did Form Copying with Speed of Reading. Although the differences were not significant, the trend observed, especially in Grade V, seems to imply that a speeded test of word copying may be more closely related to speed of reading than is speeded form copying. The same trend was also noted for the correlations of the Copying Text and of the Form Copying Tests with the other measures of reading achievement. The trend could be explained by taking into account as before, the status of word copying as a skill formally taught in the school, while form copying remains a skill learned more or less incidentally.

The findings of this study, while somewhat inconclusive, tend to confirm the results of previous investigators such as Gates (1926) in two respects:

1. Form perception (measured here by the Form Copying Test) yielded rather lower correlations with measures of reading achievement than did a test

involving letters and words (the Copying Text Test)

2. Since high and low scores in reading did not necessarily connote high and low scores respectively, in form copying, nor did high and low scores on form copying connote correspondingly high and low scores in reading, only a limited degree of form perception may be necessary for achievement in reading at the Grade III and Grade V levels.

The two experimental tests, Form Copying and the Copying Text, had relatively low reliabilities. The Copying Text Test, even with the addition of a "parallel" form was, it is felt, still too short to yield a high reliability. It would be interesting to extend this test to five or even ten minutes when, presumably, it would become at once more reliable and also more discriminatory among subjects.

Should this prove to be the case, a speeded test of word copying would seem to have value as a tentative measure of speed of reading, accuracy in word recognition, and speed of writing. Quantitative norms could be established and could be supplemented by qualitative judgments on performance. Such a test might be useful, for example, to a teacher of classes above Grade II as a rapid screening device at the

beginning of a new school year. It would, of course, be only a preliminary to the use of more searching and comprehensive testing procedures.

Comments on the Form Copying Test

The following observations on the Form Copying Test are made in the light of experience with it in the study:

1. It lacked sufficient internal consistency to differentiate adequately among the pupils. The selection and revision of items on this basis of the present investigation might provide a better test with more satisfactory reliability and discrimination.

2. The scoring criteria were not explicit enough to secure a very high degree of inter-rater agreement, and thus the inter-rater reliability of the test was reduced.

3. It shows a tendency to produce a bimodel rather than a normal distribution at the Grade V level.

4. The motor factor, by being included as a separate criterion, was unduly weighted, since this factor was undoubtedly operating in the other criteria as well.

5. The scoring criteria were too limited in

number and import, since responses with identical scores were not, when viewed subjectively, always equally "good" or "bad".

6. The test was too structured in some respects:

a. The division of the "answer" sheets into "boxes" doubtless served as a distractor to some pupils and as a guide to others in the placement, size, and orientation of their copies of the designs. This may have been a contributing factor to the homogeneity of the scores.

b. The figures were on the whole symmetrical, "good Gestalten," and in many cases were either familiar shapes or made up of familiar shapes. Less symmetrical, novel, "unclosured" figures would have permitted more re-structuring or re-organizing of the perceptions on the part of each child, and thus might have revealed more clearly the extent of his "differentiating" and "integrating" ability. A test of this nature might also be a more effective discriminator among individuals.

7. After the testing sessions some pupils commented to the writer that they wondered why they had been given the Form Copying Test, since unlike the other tests administered, Form Copying "had nothing

to do with school work." This comment hints at the possibility of certain students, at least, having adopted a different "set" in taking this test from their "set" towards the other school-oriented tasks administered to them. The importance of obtaining optimal motivation for a test of this nature thus becomes apparent.

8. The factor of speeding may have distorted the results obtained on this test. As mentioned earlier in the report, it was noted that two distinct approaches to the test appeared at the Grade V level. One group of pupils favored speed, the other, accuracy. Quantitatively their total scores may have been identical, but they were not qualitatively equal.

Yet speed is important in visual-motor tasks, especially where educational and vocational assessment is concerned. For this reason it would be desirable to include an element of speed in tests of this kind, but by timing the subjects rather than the test.

9. The test in its present form does not lend itself to administration as a group test because of the factor of "set."

Suggestions for Further Research

1. The Copying Text Test merits further investigation. An extended version of this test, if standardized, might prove to be a useful rapid screening measure of such basic school skills as word recognition, speed of reading, and speed of writing.

2. There is a need for a test of form copying which has been standardized on a representative sample of individuals from pre-school levels to maturity. Such a test should be:

a. An individual test so as to provide for optimal motivation of the subject.

b. Relatively unstructured in order to evoke the maximum "re-organizing" or "integrating" ability of the subject.

c. Timed but not speeded.

d. Highly discriminatory among subjects.

The relationship of form perception, as measured by form copying and word copying abilities, to reading achievement should be studied further with larger and more representative groups selected on an age rather than a grade-placement basis, and using standardized tests of the abilities involved.

3. The "integration hypothesis," so outlined in the review of the literature, should be tested using more refined instruments than those employed in the present study.

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A P P E N D I X   A

COPYING TEXT I

First Name: ______________________ Last Name: ______________________

Grade: ______________________ School: ______________________

DIRECTIONS: Copy this little story as quickly and plainly as you can. When the teacher says "Stop," hold up your pencil.

A little boy lived with his father in a huge forest. Every day the father went out to cut wood. One day the boy was walking through the woods with a basket of lunch for his father. Suddenly he met a huge bear. The boy was frightened, but he threw a piece of bread and jelly to the bear.

COPYING TEXT II

First Name: ______________________ Last Name: ______________________

Grade: ______________________ School: ______________________

DIRECTIONS: Copy this paragraph as quickly and as plainly as you can. When the teacher says "Stop," hold up your pencil.

All winter long the Erie Canal had been dry. Now for almost a week the water had been flowing again. Boats were moving. They were carrying lumber, salt, grain, iron, food, and flour. They carried people who were seeing the sights and travelers who had business along the way. They carried families who were seeking new homes in the West.

A P P E N D I X B

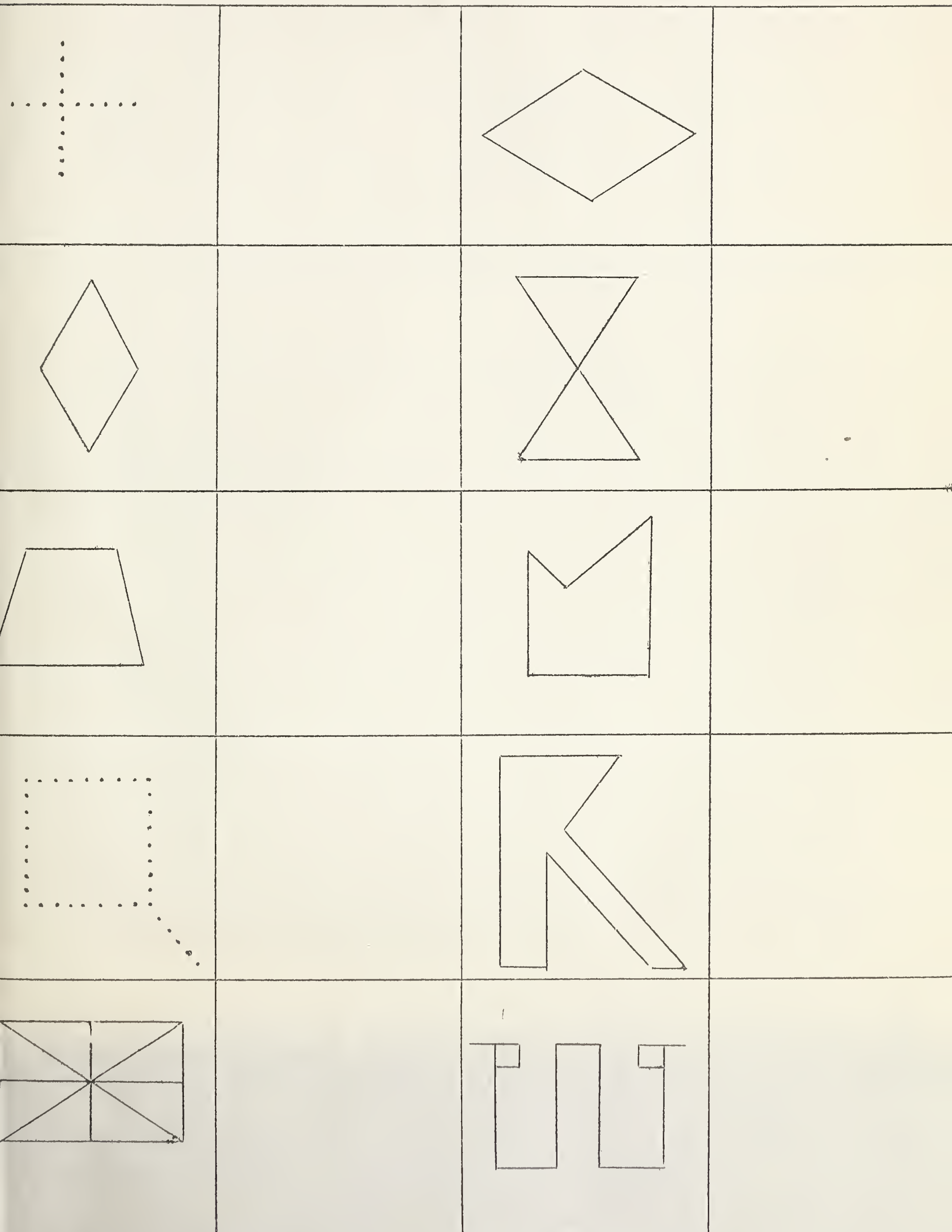
FORM COPYING

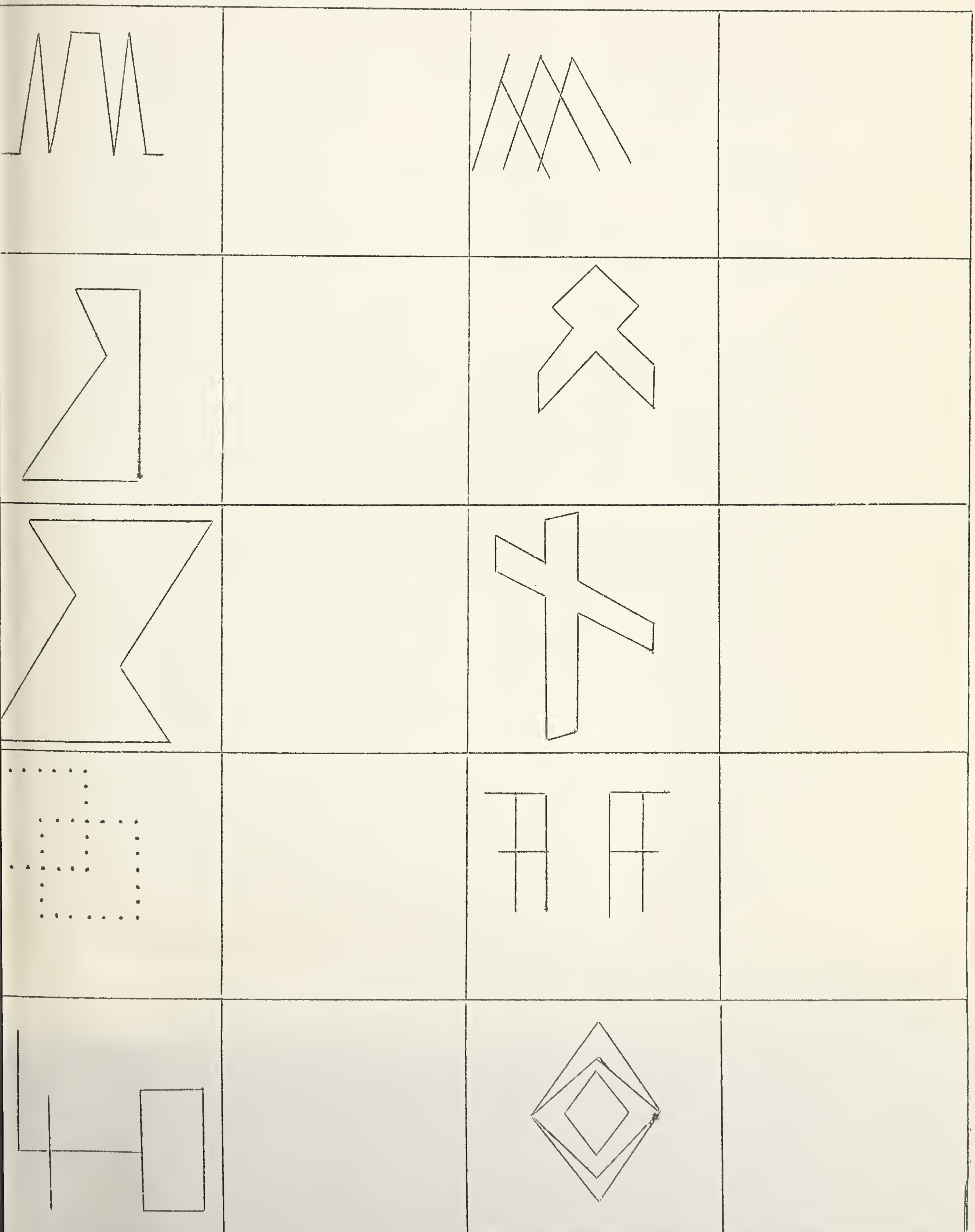
Name: First: ______________ Middle: ________________ Last: ________________

Age: ____________ Birthday: _______________________ Grade: __________

School: ______________________________________ Today's Date: ______________

DIRECTIONS: Copy each of these shapes in the space beside it as quickly and as well as you can. Go right on to the next page when you have finished this one.





APPENDIX C

TABLE I

RAW SCORES ON ALL VARIABLES, GRADE III

N = 53

Pupil	Copying Text I	Copying Text II	Copying Text Total	Gates Speed	Gates Vocab.	Gates Compre.	Gates Total	C.A. in Months	Scat Verbal	Form Copying
1	11	15	26	8	-3	10	15	109	22	21
2	2	10	12	8	16	9	33	108	20	30
3	8	3	11	8	4	9	21	108	9	21
4	10	11	21	12	19	13	44	109	21	20
5	13	21	34	12	25	15	52	101	23	30
6	11	14	25	6	14	7	27	113	15	24
7	15	19	34	10	31	20	61	107	31	35
8	17	17	34	11	23	16	50	113	23	19
9	15	17	32	11	20	13	44	111	30	28
10	9	14	23	5	19	-1	23	113	16	25
11	13	14	27	10	26	14	50	121	25	26
12	9	8	17	10	7	0	17	102	18	27
13	14	18	32	8	25	19	52	103	29	13
14	11	13	24	10	19	13	42	110	16	26
15	11	8	19	7	20	16	43	107	19	26
16	7	15	22	13	14	12	39	109	20	29
17	10	15	25	10	24	19	53	107	22	17
18	11	9	20	10	24	11	45	118	18	32
19	13	19	32	15	32	11	58	115	24	35
20	13	12	25	10	15	8	33	108	17	13
21	14	18	32	8	24	12	44	100	25	22
22	4	7	11	11	20	4	35	101	21	32
23	11	13	24	6	26	19	51	119	28	24
24	12	17	29	7	20	13	40	116	17	16
25	11	14	25	19	27	24	70	107	27	27
26	14	17	31	12	17	-4	25	108	23	27
27	18	11	29	11	20	19	50	113	24	22
28	11	12	23	9	25	18	52	109	23	28
29	10	14	24	9	22	8	39	109	23	19
30	11	17	28	19	37	25	81	107	41	40
31	11	16	27	12	20	9	41	112	22	30
32	18	15	33	10	25	15	50	101	30	25

TABLE I (continued)

N = 53

Pupil	Copying Text I	Copying Text II	Copying Text Total	Gates Speed	Gates Vocab.	Gates Compre.	Gates Total	C.A. in Months	Scat Verbal	Form Copying
33	21	20	41	18	15	18	51	104	28	27
34	13	19	32	18	25	15	58	109	26	25
35	14	14	28	15	26	27	68	115	26	28
36	20	21	41	23	31	27	81	111	39	31
37	20	22	42	13	22	13	48	107	30	31
38	14	13	27	7	9	10	26	119	13	20
39	13	16	29	17	28	24	69	106	35	34
40	11	15	26	17	32	29	78	112	41	34
41	13	18	31	6	7	10	23	116	18	34
42	17	19	36	15	27	17	59	105	31	33
43	19	18	37	20	36	19	75	105	35	28
44	11	16	27	14	25	17	56	111	33	28
45	21	20	41	26	21	17	64	110	28	30
46	12	21	33	12	26	19	57	111	29	31
47	15	15	30	18	30	32	80	104	39	22
48	8	15	23	6	17	7	30	102	24	23
49	20	18	38	9	22	11	42	116	27	41
50	5	12	17	10	21	15	46	109	24	29
51	26	22	48	19	27	19	65	109	28	27
52	11	15	26	10	37	10	57	107	23	27
53	19	22	41	15	22	14	51	109	36	42
Total	691	814	1,505	635	1,163	766	2,564	5,794	1,337	1,434
Mean	13.04	15.36	28.40	11.98	21,94	14.45	48.38	109.32	25.23	27.06
S.D.	4.51	4.06	7.83	4.65	7.83	7.10	16.47	4.91	7.03	6.27

TABLE II

RAW SCORES ON ALL VARIABLES, GRADE V

N = 31 + 31 = 62 N = 62

Pupil	Copying Text I	Copying Text II	Copying Text Total	Gates Speed	Gates Vocab.	Gates Compre.	Gates Total	C.A.in Months	Scat Verbal	Form Copying
1	28	27	55	18	43	31	92	129	43	34
2	25	28	53	10	24	22	56	135	17	36
3	35	32	67	14	28	24	66	128	22	25
4	29	26	55	15	37	32	84	129	39	26
5	27	27	54	16	33	28	77	142	41	36
6	37	35	72	23	34	30	87	137	38	38
7	26	29	55	15	37	32	84	138	35	38
8	27	26	53	10	18	24	52	139	12	26
9	19	18	37	10	21	20	51	128	18	21
10	22	20	42	17	32	24	73	128	25	25
11	26	24	50	13	28	30	71	129	30	24
12	21	23	44	7	5	2	14	168	6	26
13	16	21	37	11	14	13	38	149	16	32
14	27	26	53	8	13	9	30	149	13	35
15	27	28	55	11	16	9	36	149	18	31
16	11	25	36	6	15	22	43	131	19	28
17	22	23	45	18	42	34	94	126	41	24
18	21	21	42	10	21	27	58	145	16	38
19	27	27	54	14	32	30	76	126	27	26
20	25	26	51	18	34	27	79	131	32	35
21	28	27	55	12	19	17	48	159	14	32
22	20	26	46	12	29	24	65	136	28	31
23	28	26	54	18	21	21	60	114	28	28
24	27	27	54	15	39	33	87	137	38	40
25	26	21	47	13	0	27	40	131	21	36
26	36	36	72	21	28	27	76	152	25	17
27	26	26	52	15	25	26	66	132	20	25
28	28	28	56	13	25	24	62	155	28	22
29	26	25	51	13	27	19	59	151	27	28
30	29	33	62	22	33	32	87	143	34	30
31	23	25	48	26	35	33	94	136	41	30
32	26	21	47	10	29	23	62	150	27	44
33	26	22	48	18	44	29	91	132	45	35

TABLE II (continued)

N = 62

Pupil	Copying Text I	Copying Text II	Copying Text Total	Gates Speed	Gates Vocab.	Gates Compre.	Gates Total	C.A. in Months	Scat Verbal	Form Copying
34	18	25	43	15	32	32	79	139	23	26
35	26	24	50	21	39	29	89	134	39	27
36	15	17	32	9	29	19	57	129	21	39
37	31	34	65	19	31	25	75	129	28	48
38	13	30	43	13	24	11	48	143	13	25
39	14	23	37	16	27	24	67	143	20	51
40	26	27	53	14	25	29	68	138	22	28
41	20	24	44	14	37	26	77	120	30	29
42	22	22	44	12	26	20	58	127	23	33
43	25	26	51	10	24	17	51	133	15	10
44	23	20	43	20	49	37	106	137	51	36
45	20	23	43	13	27	25	65	128	32	34
46	27	27	54	20	37	30	87	141	38	31
47	24	22	46	18	35	30	83	139	36	34
48	20	27	47	13	35	27	75	129	29	34
49	25	22	47	10	20	19	49	145	14	35
50	26	26	52	10	34	25	69	147	32	55
51	34	36	70	20	41	32	93	133	40	45
52	26	28	54	17	27	18	62	138	20	29
53	29	18	47	15	29	17	61	130	15	31
54	28	27	55	20	35	23	78	134	25	36
55	15	22	37	12	30	18	60	130	26	40
56	19	20	39	17	27	30	74	134	38	33
57	27	27	54	22	47	33	102	133	39	41
58	22	28	50	22	40	30	92	126	41	37
59	24	24	48	11	29	32	72	131	21	26
60	20	23	43	8	31	22	61	137	20	29
61	25	22	47	12	22	20	54	147	19	27
62	25	21	46	13	36	35	84	132	35	37
Total	1,519	1,567	3,086	908	1,806	1,540	4,254	8,470	1,699	1,968
Mean	24.50	25.27	49.77	14.64	29.13	24.84	68.61	136.61	27.40	31.74
S.D.	5.26	4.05	8.33	4.38	9.27	6.97	18.28	9.56	9.96	7.08

A P P E N D I X D

TABLE I

MEAN SCORES AND GRADE EQUIVALENTS FOR
THE GATES READING SURVEY, GRADE III

Test	Mean Raw Score	Grade Equivalent
Gates Speed of Reading	11.98	4.2
Gates Reading Vocabulary	21.94	4.7
Gates Level of Comprehension	14.45	4.0
Gates Total	48.37	4.3

TABLE II

MEAN SCORES AND GRADE EQUIVALENTS FOR
THE GATES READING SURVEY, GRADE V

Test	Mean Raw Score	Grade Equivalent
Gates Speed of Reading	14.64	6.5
Gates Reading Vocabulary	29.13	5.8
Gates Level of Comprehension	24.84	6.2
Gates Total	68.61	6.2

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